Quality of Requirements Specification

J. Krogstie, Semiotic Quality Framework
SEQUAL

- **L** - language extension
- **D** - the domain
- **M** - externalised model
- **K_s** - relevant explicit knowledge of the stakeholders
- **K_m** - relevant explicit knowledge of modellers
- **I** - social actor interpretation
- **T** - technical actor interpretation
- **G** - organisationally-motivated goals of the modelling task
SEQUAL – model quality

- Physical quality
- Empirical quality
- Syntactic quality
- Semantic quality
- Pragmatic quality
- Perceived semantic quality
- Social quality
- Organisational quality
Physical quality

• Although information systems specifications and models are not of the physical kind, any model can be represented physically - e.g. on disk or paper

• Specification should be
  • Electronically stored
Empirical quality

→ **Empirical** quality deals with the variety of elements distinguished, error frequencies when being written or read, coding and ergonomics for computer-human interaction, for documentation and tools.

- Specification should be:
  - **Understandable**
    - all classes readers can easily comprehend the meaning of all requirements with a minimum of explanation.
  - **Concise**
    - it is as short as possible without affecting any other quality of the requirements specification.
Pragmatic quality

- **Pragmatic** quality is the correspondence between the model and the audience’s interpretation of it.

- Specification should be:
  - **Executable/Interpretable/Prototypable**
    - there exists a software tool capable of inputting the requirements specification and providing a dynamic behavioural model.
  - **Organised**
    - its contents are arranged so that readers can easily locate information and logical relationships among adjacent sections are apparent.
  - **Cross-referenced**
    - Cross-references are used to relate sections containing requirements with other relative requirements
Social quality

• The goal for social quality is agreement.

• Tool support
  • models created based on the different internal reality of the participants that are to agree
Syntactic quality

Syntactic quality includes correctness of lexicon, syntax and structural quality.

• Syntactic errors:
  • Syntactic invalidity
  • Syntactic incompleteness

• Automated tool support:
  • Error prevention
  • Error detection
  • Error correction
Semantic quality

→ **Semantic** quality is the correspondence between the model and the modelling domain

→ **Feasibility:**

→ Attempts at reaching a state of total validity and completeness will lead to unlimited spending of time and money on the modelling activity.

→ The time to terminate a modelling activity is thus not when the model is “perfect” (*which will never happen*), but when it has reached a state where further modelling is regarded to be less beneficial than applying the model in its current state.
Semantic quality

• **Complete**
  • everything that the software is supposed to do is included;
  • responses of the software to all realisable classes of input data in all recognisable classes of situations are included;
  • all pages are numbered, all figures and tables are numbered, named, and referenced; all terms are defined; all units of measure are provided; and all referenced material are present;
  • no sections are marked "To be determined".

• **Correct**
  • every requirement represent something required of the system to be built.

<table>
<thead>
<tr>
<th>User needs</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>the system must respond button press within 5 seconds.</td>
<td>the system must respond button press within 10 seconds.</td>
</tr>
</tbody>
</table>
Semantic quality

- **Internally consistent**
  - no subset of individual requirements stated therein conflict
    
    a) The light shall be lit when the button is pressed.
    b) When the button is released, the light shall become lit.

    a) The system should *prompt* the message
    b) The system should *cue* the message

- **Externally consistent**
  - no requirement stated therein conflict with any already base-lined project documentation
Semantic quality

• **Annotated by**
  • relative importance, relevant stability, version

• **Precise**
  • (1) numeric quantities are used whenever possible;
  • (2) the appropriate levels of precision are used for all numeric quantities.

• **Traced**
  • the origin of each of its requirements is clear

• **Traceable**
  • it is written in a manner that facilitates the referencing of each individual statement

• **Verifiable**
  • there exist finite, cost effective techniques that can be used to verify that every requirement stated therein is satisfied by the system to be built.

The system shall respond to any occurrence of request X within 20 seconds.
Semantic quality

• Achievable
  • there could exist at least one system design and implementation that correctly implements all the requirements stated in the requirements specification

• Design-independent
  • there exist more than one system design and implementation that correctly implements all requirements stated in the requirements specification

• At the right level of detail
  • specific enough so that any system built that satisfies the requirements in the specification satisfies all user needs
  • abstract enough so that all systems that satisfy all user needs also satisfy all requirements
Semantic quality

- **Modifiable**
  - structure and style are such that any changes can be made easily, completely and consistently
- **Unambiguous**
  - every requirement stated therein has only one possible interpretation

Up to 12 aircraft, the small display format shall be used. Otherwise the large display format shall be used.

<table>
<thead>
<tr>
<th>Aircraft that are non-friendly and have an unknown mission or the potential to enter restricted airspace within 5 minutes shall rise an alert.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft that are <em>either</em> non-friendly and have an unknown mission <em>or</em> have the potential to enter restricted airspace within 5 minutes shall rise an alert.</td>
</tr>
</tbody>
</table>
Orthogonal aspects

• **Reusable**
  • its sentences, paragraphs, and sections can be easily adopted and adapted for use in subsequent requirements specification.

• **Physical quality**
  • a persistent form that is available to those who potentially will want to reuse it

• **Syntactic quality**
  • syntactically correct

• **Semantic quality**
  • Similar domains
  • white-box reuse - modifiable, comprehensible and comprehended (techniques of pragmatic quality), annotated, and other

• **Social quality**
  • model integration and conflict resolution can be useful to investigate to what extent the solutions based on the model to be reused, should be reused.
THERE IS NO SUCH THING AS A PERFECT REQUIREMENTS SPECIFICATION!

- **Incomplete**
  - Redundant
  - Not understandable
- **Ambiguous**
  - Inconsistent
  - Unresolved
- **Redundant**
  - Add explanations
  - Reduce
- **Not understandable**
  - Formalise
  - Condense
- **Inconsistent**
  - Resolve
  - Expand
- **Incomplete**
  - Expand